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Abstract

This paper uses cross-country data from 1965 to 2008 to examine how ethnic heterogeneity affects the probability of technological disasters. Estimation results showed that ethnic heterogeneity increased the probability of technological disasters.

Keywords: Disaster, Ethnic fractionalization, Ethic polarization, Risk

JEL classification: D81, O11; Q54; J28; Z13

1. Introduction

Disasters have a tremendous impact on human society. In the field of social science, increasing attention is being paid to the issue of natural disasters. A number of works have considered the relationship between disasters and economic development (e.g., Kahn, 2005; Skidmore and Toya, 2002; Toya and Skidmore, 2007). Disasters can generally be categorized as either natural or technological. The probability of natural disasters is not affected by the degree of economic development, whereas the level damage inflicted by natural disasters is (Kahn, 2005). In contrast, the probability of a technological disaster is largely influenced by human error—this is the differentiating feature between technological and natural disasters.

Previous works state ethnic heterogeneity as a determining factor in the quality of a government (La Porta et al. 1999; Alesina et al., 2003). Easterly and Levine (1997) suggest that ethnic heterogeneity has a direct detrimental influence on economic growth. Ethnic heterogeneity has a negative effect on economic development through the reduction of investment and the probability of conflict (Mauro, 1995; Montalvo and Reynal-Querol, 2005a, 2005b).[1] Vigdor (2004) provides evidence that ethnic and other heterogeneity in society impedes collective action.

Technological disasters are likely to occur when collective action is not well-organized, because cooperation and communication among workers are important in ensuring that technology is well-functioning. However, while the effect of institution on natural disasters has been well analyzed, very few researchers, with the exception of Kahn (2005),[2] have looked at the relationship between technological disasters and

[1] In line with ethnic heterogeneity, Montalvo and Reynal-Querol (2003) discussed the influence of religious heterogeneity on economic development.

[2] Kahn (2005) mainly investigated the determinants of death caused by natural disasters. In addition, he also provided supplementary results regarding the

institution. Therefore, it is of some value to examine the relationship between institution and the probability of technological disasters. This paper investigates how ethnic heterogeneity affects the probability of technological disasters.

2. Data and Model

For the estimations in this paper I used annual data on technological disasters in 106 countries, from 1965 to 2008. The definitions and the descriptive statistics of variables used in this paper are presented in Table 1. Classical works have previously used an ethnic fractionalization index to capture ethnic heterogeneity (Mauro, 1995; Easterly and Levine, 1997; La Porta et al., 1999). In addition, ethnic polarization has also been used as an alternative measure (Montalvo and Reynal-Querol, 2005a, 2005 b; Reynal-Querol, 2002). Thus, to check the robustness of the estimation results, I used both ethnic fractionalization and ethnic polarization as proxy variables for ethnic heterogeneity.[3] Ethnic heterogeneity can result in conflict, hampering the cooperation and communication required to reduce the risk of technological accidents. If ethnic heterogeneity increases the probability of technological disasters, then ETPOL (or ETFRA) should take a positive sign. Due to a limitation in the data used in this study, ETPOL and ETFRA take the same values for the 1965–2008 period.

The data on technological disasters used in this study can be considered to be typical count data. The Poisson regression model has been widely used to study such data (Greene, 2008). Thus, I used the Possion model to examine the data and the estimated function takes the following form:

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determinants of death caused by technological disasters.

[3] Data on ethnic fractionalization and polarization is available at http://www.econ.upf.edu/~reynal/data_web.htm (accessed on June 1, 2011).

$$TEDIS_{it} = \alpha_0 + \alpha_1 ETPOL\ (or\ ETFRA)_i + \alpha_2 GDP_{i\,t} + \alpha_3 POP_{it} + \alpha_4 OPEN_{it} + \alpha_5 GOVSIZ_{it} + \alpha_6 PRSCH_i + \alpha_7 SESCH_i + \alpha_8 AGRAT_{it} + m_t + e_{it},$$

where TEDIS represents the subjective risk of a nuclear accident in country *i* and in year *t*. *m* is the year-specific effect and is controlled for by year dummies. *e* is an error term and α represents the regression parameters. TEDIS is the number of technological disasters that have occurred since 1965.[4] TEDIS was collected from EM-DAT (Emergency Events Database).[5] Apart from the key variables explained earlier (TEDIS, ETPOL, and ETFRA), and in line with previous works examining the determinants of disaster damage (e.g., Kahn, 2005; Toya and Skidmore, 2007), the control variables are incorporated as independent variables as follows. Economic factors are captured by GDP per capita (GDP), population (POP), economic openness (OPEN), size of government (GOVSIZ), and proxies for human capital are expressed as primary school and secondary school enrollment rates (PRSCH and SESCH). As there was a lack of data, PRSCH and SESCH are only available for 1980 within the period 1965–2008. Therefore, PRSCH and SESCH are values for 1980 and are constant over time. In addition, the likelihood of technological disasters appears to depend on industrial structure and, therefore, rates for agricultural value-added (AGRAT) were also included.[6] The greater AGRAT is, the lower the rates for the industrial sector. As a

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[4] A technological disaster is an industrial accident, miscellaneous accident, or a transport accident.

[5] TEDIS was obtained from the International Disaster Database (http://www.emdat.be. accessed on June 1, 2011).

[6] With the exception of the value-added rates, the World Bank (2010) provided rates for agriculture employees . However, the employee rate was not available for a number of countries. Thus, the rate of value-added was used. Estimation results did not change when AGRAT was not included. These results are available from the author upon request.

result, the probability of technological disasters decreases. All control variables were collected from the World Bank (2010).

3. Results

The estimation results for the Poisson model are exhibited in Table 2. I purposely focused on the results of the proxies for ethnic heterogeneity. The results when ETPOL is included are presented in columns (1)–(4), whereas those for when ETFRA is included are in columns (5)–(8). Z-statistics are calculated based on the robust standard errors to alleviate heteroscedasticity. Data regarding some variables used in this paper are not available for some countries. As is shown in Table 2, increases in independent variables leads to a decrease in observations. Hence, results for the full model exhibited in columns (1) and (5) are less likely to suffer from omitted variables bias, although the sample size is smaller than for other results. Results in columns (4) and (8) are more likely to suffer from the bias, while the sample size is larger. ETPOL and ETFRA take the anticipated positive sign in all estimations. Further, they are statistically significant at the 1% level, with the exception of column (4) where statistical significance is at the 10% level. The results for ETPOL and ETFRA are robust for alternative specifications. These results lead me to assert that ethnic heterogeneity increases the probability of technological disasters.

The significant negative sign for GDP and OPEN indicate that higher income and greater openness reduce the probability of technological disasters. Technology has advanced in those countries that are more developed. Higher levels of openness can be regarded as the proxy for the degree of transfer of technological knowledge from abroad. This transfer enables people to reduce risk, which is in line with findings that GDP and openness reduce the death rate of natural disasters (Toya and Skidmore, 2007). As anticipated, AGRAT yields a significant negative sign.

4. Conclusions

Using cross-country data from 1965 to 2008, this paper examined how ethnic heterogeneity affects the probability of technological disasters. Estimation results suggest that ethnic heterogeneity is positively related to the probability of technological disasters. That is, people that live in an ethnically heterogeneous society are more likely to experience technological disasters, leading to economic loss. Ethnic heterogeneity affects economic development, and a facet of this relationship, albeit one that has not yet been fully explored, can be seen after a technological disaster.

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Table 1 Definition of variables and descriptive statistics

	Definition	Mean	Standard deviation
TEDIS	Number of technological disasters	1.10	3.78
ETPOL	Index of ethnic polarization	0.51	0.24
ETFRA	Index of ethnic fractionalization	0.43	0.27
GDP	GDP per capita (thousand dollars)	6.26	8.69
POP	Population (millions)	38.3	134.0
OPEN	Trade/GDP (%)	70.4	46.3
GOVSIZ	Government size (government expenditure/GDP) (%)	15.2	6.2
PRSCH	Gross primary school enrollment rate in 1980 (%)	92.2	25.1
SESCH	Gross secondary school enrollment rate in 1980 (%)	46.3	29.4
AGRAT	Agricultural value-added/GDP (%)	18.6	15.3

Table 2 Poisson estimation: dependent variable is TEDIS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETPOL	1.02***	0.95***	0.99***	0.26*				
	(7.76)	(7.19)	(8.06)	(1.80)				
ETFRA					0.91***	0.73***	0.67***	1.08***
					(6.53)	(5.12)	(4.77)	(6.63)
GDP	–0.05***	–0.04***	–0.001	–0.005	–0.05***	–0.03***	–0.001	0.001
	(–8.13)	(–6.43)	(–0.21)	(–1.34)	(–7.78)	(–5.91)	(–0.24)	(0.39)
POP	0.001***	0.001***	0.001***	0.002***	0.001***	0.001***	0.001***	0.002***
	(16.4)	(17.3)	(20.6)	(28.2)	(12.4)	(13.8)	(15.4)	(26.4)
OPEN	–0.02***	–0.01***	–0.01***		–0.01***	–0.01***	–0.01***	
	(–14.5)	(–12.8)	(–13.9)		(–13.4)	(–11.8)	(–12.7)	
GOVSIZ	–0.04***	–0.03***	–0.01**		–0.03***	–0.02***	–0.01	
	(–5.10)	(–4.42)	(2.27)		(–3.61)	(–3.11)	(–0.77)	
PRSCH	–0.003*	–0.001			–0.002	–0.0001		
	(–1.95)	(–0.85)			(–1.47)	(–0.04)		
SESCH	0.01***	0.02***			0.01***	0.02***		
	(6.95)	(8.29)			(6.25)	(7.67)		
AGRAT	–0.02***				–0.03***			
	(–6.62)				(–7.16)			
Constant	–0.73	–2.42***	–1.70***	–2.53***	–0.81*	–2.56***	–1.72***	–2.82***
	(–1.49)	(–6.85)	(–5.60)	(–8.74)	(–1.71)	(–7.34)	(–5.75)	(–10.0)
Pseudo R^2	0.56	0.55	0.53	0.47	0.56	0.55	0.53	0.48
Observations	3163	3604	3804	4727	3163	3604	3804	4727

Note: Values in parentheses are z-statistics calculated using robust standard errors. Year dummies and regional dummies (Asia, Africa and South America dummies) are included in all estimations but the results are not reported to save space. *, **, and *** denote significance at the 10%, 5%, and 1 % levels, respectively.